Final Report
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entitled

MAPPING PLANETARY AND SATELLITE SURFACES

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This document constitutes the final report for Grant NAGW-1306 entitled *Mapping Planetary and Satellite Surfaces.* This was a 3-task proposal to conduct research in planetary geoscience mapping. Task 1 involved the compilation of research results into a NASA Atlas of the Solar System, Task 2 involved Mars rover tests, and Task 3 involved continuation of studies of martian landing sites.

Task 1: Solar System Atlas

The last decade and a half have seen exploratory probes sent throughout most of the Solar System. Many of these probes have carried imaging systems that have enabled mapping of the solid-surface planets and satellites. As part of the NASA Planetary Program in cartographic research, global maps, systematic map-quadrangles, and special purpose maps have been produced to exacting mapping standards. The objective of this task was to coordinate a joint NASA-U.S. Geological Survey project to synthesize research results into a Solar System Atlas of the planets and satellites. For the first time, this synthesis provides a systematic collection of planetary and satellite maps, a gazetteer and index to named features, and information on planetary cartography, geodesy, and geology. Such an atlas would be of value to planetary scientists, and all who wish to share in Solar System exploration.

The following roles and responsibilities were defined for the participants:

1. R. Greeley (Arizona State University) had overall responsibility for synthesizing research results in the

Atlas and authoring sections dealing with geology and background information on planets. In addition, he was responsible for the generation of some of the special map products to be incorporated within the Atlas, utilizing the Planetary Image Processing System at Arizona State University.

2. Haig Morgan (U.S. Geological Survey) was responsible for the conversion of planetary maps and charts into digital forms for reprojection into standard scales and formats in the Atlas and the production of selected special purpose maps; Ray Batson (co-author with Greeley) was responsible for writing sections dealing with planetary cartographic practices and principles.

Production of the Atlas was carried forward with completion of the base maps, the geological maps, and the text; the text was reviewed and revised and the materials were forwarded to Cambridge University Press. The Atlas was published in early 1997 and is available through Cambridge University Press and NASA.

Task 2: Rover Field Tests

Tests with the Russian rover were conducted in spring, 1994, in the Mojave Desert, in the winter, 1995, at Kilauea Volcano, Hawaii, and near Tuba City, Arizona, in the fall, 1996. Discussions with the project personnel (Linkin) led to the suggestion that the Amboy lava field be used for both mobility tests and experiments for science. The Amboy lava field and the Kilauea crater are good analogs for Mars, have been used in previous martian tests, and are logistically accessible. The Tuba

City site was selected as an analog for a Martian sedimentary geology environment.

This task involved assessing the utility of simulated descent images to map out rover traverses from an operational and scientific perspective. Using planetary scientists and students unfamiliar with the site, two scenarios were run, one in which descent images were available for planning the rover traverse and the second in which such images were not available. The rover was then operated remotely following the two scenarios to carry out a set of simulated mission objectives. The differences between the two scenarios were then compared and assessed.

Task 3: Mars Landing Site Activities

Many of the missions planned for the exploration of Mars in the future involve the selection of landing sites, or the identification of areas of interest to be "targeted" for acquisition of additional data, as may be obtained during the Mars Global Surveyor Missions. Sites range in complexity from relatively simple areas as may be targeted for hard landers, through complex sites involving roving vehicles and sample returns, to highly demanding sites for human exploration. Selection of such sites requires consideration of mission constraints, scientific objectives and criteria, and available technology.

Numerous study groups have been established to assess future Mars missions. Reports and informal documents from these groups often include criteria for site selection and, in many cases, provide case studies of candidate sites. The case studies range

from minimal descriptions to highly detailed analyses using all available data.

This task was to provide a framework for various landing site studies by documenting the development of landing site criteria and cataloging case studies in a consistent format for publication as NASA documents. In addition, detailed case studies were conducted for specific sites of scientific interest, and published as *NASA Reference Publication 1238*, Aug. 1990, 194 p., and *NASA Reference Publication 1238*, 2nd Edition, 1994, 392 p.